CALIBRATING
TYPE B PRESSURE AIR METERS
FOR AIR CONTENT & UNIT WEIGHT
AASHTO T 152 & T 121

1.0 SCOPE

1.1 This method covers the procedures for calculating the volume of the measuring bowl and calibrating a Type B pressure air meter and its calibration vessel in the laboratory for field use in measuring air content and unit weight of portland cement concrete.

1.2 A field verification form is also included. This form is to accompany the completed laboratory calibration form issued with the air meter for subsequent field verification of air meter constancy by project personnel.

2.0 REFERENCES

2.1 AASHTO STANDARDS

M 231 Weighing Devices Used in the Testing of Materials

T 19 Unit Weight and Voids in Aggregate

T 121 Mass per Cubic Meter (Cubic Foot), Yield, and Air Content (Gravimetric) of Concrete

T 152 Air Content of Freshly Mixed Concrete by the Pressure Meter

3.0 APPARATUS

3.1 Balance, M231 Class G5, readable to 1 g and accurate to 2 g or 0.1 percent of the test load, whichever is greater

3.2 Ruler, readable to 1.0 mm

3.3 Thermometer, readable to 0.1°C with a range of 15°C to 30°C

3.4 Glass Plate, a minimum of 6 mm thick and at least 25 mm larger than the diameter of the measuring bowl

3.5 Tubes, one short straight piece and one J-shaped piece, each threaded at one end

3.6 Calibration Vessel, a field use measure having an internal volume equal to a percent of the volume of the measuring bowl corresponding to the approximate percent of air expected to be found in the concrete

4.0 PROCEDURE -- MAINTENANCE OF AIR METER

4.1 Check function of hand pump, petcocks, and clamps. Clean, lubricate, and adjust as necessary

4.2 Disassemble pressure release valve from air chamber. Clean, lubricate, and reassemble on annual basis

4.3 Remove deposits of hardened concrete from inside of air meter bowl

5.0 PROCEDURE -- VERIFICATION OF DIMENSIONS

5.1 Using the ruler, determine the following dimensions of the bowl
   a. Interior height
   b. Inside diameter at the top

5.2 Calculate diameter / height ratio and validate to be between 0.75 and 1.25

5.3 Measure capacity of bowl to be 0.006 m^3 or greater

5.4 Attempt to insert 0.25 mm feeler gauge between glass plate and rim

5.5 Bowl and cover assembly is sufficiently rigid to limit effect of expansion factor to not more than 0.1 percent of air content on the indicator scale within range of operation

6.0 PROCEDURE -- INITIAL FUNCTION CHECK OF AIR METER

6.1 Close bleed valve and pressurize air chamber to stabilized reading at maximum initial pressure line (IPL) mark

6.2 Check for loss in pressure do to air leaks. If pressure loss does not drop more than 1/2 IPL mark in 90-second time interval, function of air meter is considered satisfactory.

6.3 If pressure loss exceeds above requirement check air meter for leaks at pump, cap or base of chamber, bleed valve, and pressure gage. Repair as necessary before proceeding with calibration

7.0 PROCEDURE -- BOWL VOLUME

7.1 Set out air meter bowl and sufficient clean tap water in appropriate container and allow equipment and water to a acclimate to room temperature

7.2 Apply film of grease to top rim of bowl

7.3 Determine the tare weight of the bowl and glass plate

7.4 Fill the measuring bowl with room temperature water and cover with the glass plate in such a way as to eliminate bubbles and excess water

7.5 Weigh the measuring bowl, glass plate, and water

7.6 Remove glass plate and measure temperature of water

7.7 Determine density of water from attached table

7.8 Determine the bowl (bucket) volume to four significant figures (0.000)

7.9 Determine factor for bowl by taking the inverse of the volume to four significant figures (0.0000)

7.10 With permanent marker, record the volume and factor on the outside of the measuring bowl in English units

8.0 PROCEDURE -- AIR METER CALIBRATION

8.1 Screw the short tube into the threaded petcock hole on the underside of the cover assembly. Place the cover assembly on the air meter bowl filled with room temperature water. Open the petcocks on the cover assembly. Using a rubber syringe, inject water through the petcock having the extension until all air is expelled from the second petcock. Jar the meter gently to release trapped air

8.2 Pump air into the air chamber until the gage hand is stabilized at the expansion factor indicated (initial pressure line). Tap the gage lightly to help stabilize the gage hand

8.3 Close petcocks and release the air to the measuring bowl. If the initial pressure is correctly positioned, the gage hand should read zero percent. The initial pressure line shall be adjusted if two or more determinations show the same variation from zero percent and the procedure repeated to check the adjusted initial pressure line

8.4 Check for pressure loss exceeding ½ IPL mark in 90 seconds. Repair any leaks from the petcocks or seal between cover assembly and bowl

8.5 Calculate the Target Weight of water to be removed for each of the target air contents by multiplying the appropriate percentage value by the weight of water recorded

8.6 Thread the J-tube into the same petcock having the short extension in the base of the cover assembly

8.7 Remove water from the assembly to the specific weight targeted for 4.0% air content. Control the flow by opening the petcock with the J-tube attached and cracking the air valve between the air chamber and the measuring bowl, or by opening the air valve and using the petcock to control flow. Release the air at the free petcock. Open the other petcock and let the water in the curved tube flow back into the measuring bowl. There is now a percent of air equal to the effective volume of the water removed from the measuring bowl. Measure the actual weight of water removed and record it in the table. Divide this value by weight of water in the bowl and multiply by 100 to determine the Actual Air Content.

8.8 With the free petcock open, pump air pressure into chamber to initial pressure line in accordance with 8.2. Close petcocks and immediately press thumb lever. Wait a few seconds for exhaust air to warm to normal temperature and for gage hand to stabilize after tapping lightly. The dial should now read exactly the value of R. If two or more tests show a constant variation of more than 0.1% points from R, remove the gage glass and reset the dial hand to R.

8.9 Repeat 8.7 & 8.8 for calibration at each R-value for the remaining Target Air contents of 6.0%, 8.0%, & 10.0%. If two tests show a constant variation of more than 0.1% at any of these R values, repeat the calibration sequence from 8.1 to 8.9 after adjustments are made.

9.0 CALIBRATING -- CALIBRATION VESSEL FOR FIELD VERIFICATION

9.1 Evaluate condition of vessel to determine if wall has been damaged or significantly dented to reduce volume

9.2 Determine the Tare Weight of the Calibration Vessel

9.3 Repeat 8.1, 8.2, 8.6 & 8.7 to fill the calibration vessel full of room temperature water. Determine the weight of the Calibration Vessel filled with water

9.4 Determine the weight of room temperature water in the calibration vessel

9.5 Determine the air content represented by the effective volume of the calibration vessel

9.6 With permanent marker, identify the representative air content and serial number on the outside wall of the calibration vessel

10.0 VERIFICATION -- FIELD CHECK OF AIR METER CONSTANCY

10.1 Set out air meter bowl and sufficient clean tap water in appropriate container and allow equipment and water to acclimate to room temperature

10.2 Screw the short tube into the threaded petcock hole on the underside of the cover assembly. Place the cover assembly on the air meter bowl filled with room temperature water. Open the petcocks on the cover assembly. Using a rubber syringe, inject water through the petcock having the extension until all air is expelled from the second petcock. Jar the meter gently to release trapped air.

10.3 Thread the J-tube to the same petcock having the short extension in the base of the cover assembly

10.4 Pump sufficient air into the air chamber to aid in the removal of water from the assembled air meter

10.5 Remove water from the assembly to the calibration vessel. Control the flow by opening the petcock with the J-tube attached and cracking the air valve between the air chamber and the measuring bowl, or by opening the air valve and using the petcock to control flow. After filling the vessel, release the air at the free petcock. Open the other petcock and let the water in the curved tube flow back into the measuring bowl. There should now be a percent of air equal to the value identified on the calibration vessel.

10.6 With the petcocks open, pump air pressure into chamber to obtain a stabilized reading of the gage hand at the initial pressure line (expansion factor) identified for the air meter. Close petcocks and immediately press thumb lever to release pressure. Wait a few seconds for exhaust air to warm to normal temperature and for gage hand to stabilize after tapping lightly, while the release valve is maintained in the open position. The gage hand should now read the percent of air equal to the value identified on the calibration vessel. If two or more checks show a constant variation of more than 0.1% points, the air meter should be sent to the District for recalibration.

10.7 Repeat 10.5 & 10.6 for calibration verification at twice the air content indicated on the calibration vessel. If two or more checks show a constant variation of more than 0.1% points, the air meter should be sent to the District for recalibration.

LABORATORY CALIBRATION OF AIR METER

Dimensions of Bowl

A. Inside diameter of bowl: __ __ __ mm
B. Inside height of bowl: __ __ __ mm
C. Diameter / Height Ratio: (A / B) = __ . __ __
D. Capacity of bowl: 3.14 $(A/2)^2 \times B / 10^9$ = __ . __ __ __ m^3
E. Validate smoothness and plainness of rim

Bucket Volume & Factor Determination

F. Tare Weight of bowl & glass plate: __ __ __ __ grams
G. Total Weight of water, bucket, & glass plate: __ __ __ __ grams
H. Weight of water: (G - F) __ __ __ __ grams
I. Temperature of water: __ __ . __ °C
J. Density of Water: __ __ __ __ __ __ kg/m^3 x 1000 = __ __ __ __ __ __ g/m^3
K. Bowl Volume: (H/J) = 0.00__ __ __ __ m^3 × 35.315 ft^3/m^3 = 0. __ __ __ __ ft^3
L. Bucket Factor: (1/K) __ __ __ __ __ (English)

Calibration of Air Meter

M. Determine expansion factor (Initial Pressure Line, IPL)_____ (dimensionless)
N. Check for Pressure loss and repair leaks at petcocks or seal between lid assembly and bowl
O. Calibration verification as tabulated below:

Target Air Content	Weight of Water To Be Removed	Weight of Water Actually Removed	Actual Air Content, R	Gage Reading on Air Meter	
				Reading 1*	Reading 2*
4.0 %	__ __ __ grams	__ __ __ grams	__ . __ __ %	__ . __ __ %	__ . __ __ %
6.0 %	__ __ __ grams	__ __ __ grams	__ . __ %	__ . __ %	__ . __ %
8.0 %	__ __ __ grams	__ __ __ grams	__ . __ %	__ . __ %	__ . __ %
10.0 %	__ __ __ grams	__ __ __ grams	__ . __ %	__ . __ %	__ . __ %

* Reading 1 & 2 must be within 0.05 % Points to confirm correct calibration measurement.

P. Gage Reading Air Content must be within 0.1% of Actual Air Content.

Calibration of the Calibration Vessel

Q. Wall of vessel has not been damaged or significantly dented to reduce volume.
R. Tare Weight of Calibration Vessel __ __ __ __ grams
S. Total Weight of Calibration Vessel filled with room temperature water __ __ __ __ grams
T. Weight of water: (S - R) __ __ __ __ grams
U. Air Content: (T/H) × 100 = (__ __ __ __ g / __ __ __ __ g) × 100 = __ . __ % Points

REMARKS:

_____
_____
_____
_____

Serial Number of Air Meter: _____ Date of Calibration:_____
Next due date:_____

Calibrated By:_____
Checked By:_____

FIELD VERIFICATION OF AIR METER CONSTANCY

Serial Number of Air Meter: _______________

Laboratory Calibration Values From Page 1		Gauge Reading	
		1st Trial	2nd Trial
Initial Pressure Line, M (dimensionless)			
Air Content Represented by 1 Calibration Vessel, U % Pts.	%		
Air Content Represented by 2 Calibration Vessel, 2U % Pts.	%		

Verified By: ______________________ Date: ______________

Next Due Date: ______________

Laboratory Calibration Values From Page 1		Gauge Reading	
		1st Trial	2nd Trial
Initial Pressure Line, M (dimensionless)			
Air Content Represented by 1 Calibration Vessel, U % Pts.	%		
Air Content Represented by 2 Calibration Vessel, 2U % Pts.	%		

Verified By: ______________________ Date: ______________

Next Due Date: ______________

Laboratory Calibration Values From Page 1		Gauge Reading	
		1st Trial	2nd Trial
Initial Pressure Line, M (dimensionless)			
Air Content Represented by 1 Calibration Vessel, U % Pts.	%		
Air Content Represented by 2 Calibration Vessel, 2U % Pts.	%		

Verified By: ______________________ Date: ______________

Next Due Date: ______________

Remarks:

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Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3	Temp oF	Density lb/ft3
60.0	62.3660	63.0	62.3480	66.0	62.3290	69.0	62.3080	72.0	62.2850	75.0	62.2610	78.0	62.2340	81.0	62.2060	84.0	62.1760
60.1	62.3654	63.1	62.3474	66.1	62.3283	69.1	62.3073	72.1	62.2842	75.1	62.2601	78.1	62.2331	81.1	62.2050	84.1	62.1750
60.2	62.3648	63.2	62.3468	66.2	62.3276	69.2	62.3066	72.2	62.2834	75.2	62.2592	78.2	62.2322	81.2	62.2040	84.2	62.1740
60.3	62.3642	63.3	62.3462	66.3	62.3269	69.3	62.3059	72.3	62.2826	75.3	62.2583	78.3	62.2313	81.3	62.2030	84.3	62.1730
60.4	62.3636	63.4	62.3456	66.4	62.3262	69.4	62.3052	72.4	62.2818	75.4	62.2574	78.4	62.2304	81.4	62.2020	84.4	62.1720
60.5	62.3630	63.5	62.3450	66.5	62.3255	69.5	62.3045	72.5	62.2810	75.5	62.2565	78.5	62.2295	81.5	62.2010	84.5	62.1710
60.6	62.3624	63.6	62.3444	66.6	62.3248	69.6	62.3038	72.6	62.2802	75.6	62.2556	78.6	62.2286	81.6	62.2000	84.6	62.1700
60.7	62.3618	63.7	62.3438	66.7	62.3241	69.7	62.3031	72.7	62.2794	75.7	62.2547	78.7	62.2277	81.7	62.1990	84.7	62.1690
60.8	62.3612	63.8	62.3432	66.8	62.3234	69.8	62.3024	72.8	62.2786	75.8	62.2538	78.8	62.2268	81.8	62.1980	84.8	62.1680
60.9	62.3606	63.9	62.3426	66.9	62.3227	69.9	62.3017	72.9	62.2778	75.9	62.2529	78.9	62.2259	81.9	62.1970	84.9	62.1670
61.0	62.3600	64.0	62.3420	67.0	62.3220	70.0	62.3010	73.0	62.2770	76.0	62.2520	79.0	62.2250	82.0	62.1960	85.0	62.1660
61.1	62.3594	64.1	62.3414	67.1	62.3213	70.1	62.3002	73.1	62.2762	76.1	62.2511	79.1	62.2241	82.1	62.1950	85.1	62.1649
61.2	62.3588	64.2	62.3408	67.2	62.3206	70.2	62.2994	73.2	62.2754	76.2	62.2502	79.2	62.2232	82.2	62.1940	85.2	62.1638
61.3	62.3582	64.3	62.3402	67.3	62.3199	70.3	62.2986	73.3	62.2746	76.3	62.2493	79.3	62.2223	82.3	62.1930	85.3	62.1627
61.4	62.3576	64.4	62.3396	67.4	62.3192	70.4	62.2978	73.4	62.2738	76.4	62.2484	79.4	62.2214	82.4	62.1920	85.4	62.1616
61.5	62.3570	64.5	62.3390	67.5	62.3185	70.5	62.2970	73.5	62.2730	76.5	62.2475	79.5	62.2205	82.5	62.1910	85.5	62.1605
61.6	62.3564	64.6	62.3384	67.6	62.3178	70.6	62.2962	73.6	62.2722	76.6	62.2466	79.6	62.2196	82.6	62.1900	85.6	62.1594
61.7	62.3558	64.7	62.3378	67.7	62.3171	70.7	62.2954	73.7	62.2714	76.7	62.2457	79.7	62.2187	82.7	62.1890	85.7	62.1583
61.8	62.3552	64.8	62.3372	67.8	62.3164	70.8	62.2946	73.8	62.2706	76.8	62.2448	79.8	62.2178	82.8	62.1880	85.8	62.1572
61.9	62.3546	64.9	62.3366	67.9	62.3157	70.9	62.2938	73.9	62.2698	76.9	62.2439	79.9	62.2169	82.9	62.1870	85.9	62.1561
62.0	62.3540	65.0	62.3360	68.0	62.3150	71.0	62.2930	74.0	62.2690	77.0	62.2430	80.0	62.2160	83.0	62.1860	86.0	62.1550
62.1	62.3534	65.1	62.3353	68.1	62.3143	71.1	62.2922	74.1	62.2682	77.1	62.2421	80.1	62.2150	83.1	62.1850	86.1	62.1539
62.2	62.3528	65.2	62.3346	68.2	62.3136	71.2	62.2914	74.2	62.2674	77.2	62.2412	80.2	62.2140	83.2	62.1840	86.2	62.1528
62.3	62.3522	65.3	62.3339	68.3	62.3129	71.3	62.2906	74.3	62.2666	77.3	62.2403	80.3	62.2130	83.3	62.1830	86.3	62.1517
62.4	62.3516	65.4	62.3332	68.4	62.3122	71.4	62.2898	74.4	62.2658	77.4	62.2394	80.4	62.2120	83.4	62.1820	86.4	62.1506
62.5	62.3510	65.5	62.3325	68.5	62.3115	71.5	62.2890	74.5	62.2650	77.5	62.2385	80.5	62.2110	83.5	62.1810	86.5	62.1495
62.6	62.3504	65.6	62.3318	68.6	62.3108	71.6	62.2882	74.6	62.2642	77.6	62.2376	80.6	62.2100	83.6	62.1800	86.6	62.1484
62.7	62.3498	65.7	62.3311	68.7	62.3101	71.7	62.2874	74.7	62.2634	77.7	62.2367	80.7	62.2090	83.7	62.1790	86.7	62.1473
62.8	62.3492	65.8	62.3304	68.8	62.3094	71.8	62.2866	74.8	62.2626	77.8	62.2358	80.8	62.2080	83.8	62.1780	86.8	62.1462
62.9	62.3486	65.9	62.3297	68.9	62.3087	71.9	62.2858	74.9	62.2618	77.9	62.2349	80.9	62.2070	83.9	62.1770	86.9	62.1451